UCLouvain

lphys1342

2020

Quantum Physics 2

Due to the COVID-19 crisis, the information below is subject to change, in particular that concerning the teaching mode (presential, distance or in a comodal or hybrid format).

5 credits	45.0 h + 22.5 h	Q1

Teacher(s)	Ringeval Christophe ;
Language :	French
Place of the course	Louvain-la-Neuve
Prerequisites	*The prerequisite(s) for this Teaching Unit (Unité d'enseignement – UE) for the programmes/courses that offer this Teaching Unit are specified at the end of this sheet.*
Main themes	This lecture, targeted to students being already familiar with quantum concepts and wave mechanics, will present the theory of non-relativistic quantum mechanics from its mathematical roots to its practical applications. Numerous examples will be taken from various domains such as astrophysics, atomic physics, particle physics, solid state physics, '
Aims	**a. Contribution of the teaching unit to the learning outcomes of the programme** 1.1, 1.3, 1.4, 2.1, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6 **b. Specific learning outcomes of the teaching unit** 1 At the end of teaching unit, the student will be able able to: 1. solve alone physical problems whose solutions are not known in advance ; 2. choose and use adequate mathematical methods to solve these problems ; 3. correctly perform the analytical calculations that come with the mathematical methods. - - - - *The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled "Programmes/courses offering this Teaching Unit".*
Evaluation methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** Evaluation is based on a 4 hours long written exam that tests both the theoretical concepts presented in the teaching unit as well as their application to concrete physical problems. Basic knowledge of the teaching unit is assessed, but the main exam objective is to assess the capability of analysing and solving a new problem of quantum physics. Mastering analytical calculations and presenting coherently the corresponding results are mandatory.
Teaching methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** Teaching activities are alternating between traditional lecturing, guided learning and inquiry-based learning during the exercise sessions. On the one hand, the traditional lectures aim at introducing, in a clear and rigorous way, the concepts that support the foundations of quantum mechanics. Illustrations will be provided in a guided learning way in order to initiate students to the cognitive reasoning of the physicist. The introduction of mathematical models, as well as the ways to solve them, will be presented in a explicit, interactive and pedestrian manner on the black board. Exercise sessions, on the other hand, aim at the cognitive training of the students to solve a completely new problem in quantum mechanics. Problems are given one week in advance and the students are expected to work alone on these questions before showing up in class. The class itself consists in the pedestrian presentation of the solution, either by the teacher, or by the students themselves, in an inverted class.
Content	The content of the teaching unit is the minimal required knowledge to tackle any problem involving modern non-relativistic quantum mechanics. This constitutes one of the pillar supporting the tower of competencies required for the physicist and the engineer. Various illustrations will be presented that should convince the students on how deep our society relies on quantum mechanics, examples taken from astrophysics to emerging technologies. Lectures will start from the following tree: ' Particle in a central potential ' Formalism of Quantum Mechanics ' Angular momentum ' The hydrogen atom ' Spin ' Adding angular momentum ' Time-independent perturbation theory

	' Fine an hyperfine structure of the hydrogen atom ' Time-dependent perturbation theory ' Quantum dynamics ' Introduction to path integral
Bibliography	- « Mécanique Quantique I et II », Cohen-Tannoudji, Diu, Laloë - « Mécanique Quantique I et II », Messiah - « Understanding Quantum Mechanics », Omnès. - « Quantum Mechanics », Landau, Lifshitz - « Quantum Mechanics », Brandsen, Joachain - « Speakable and Unspeakable in Quantum Mechanics », Bell.
Faculty or entity in charge	PHYS

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Aims
Additionnal module in Mathematics	APPMATH	5		
Bachelor in Physics	PHYS1BA	5	LPHYS1241	
Minor in Physics	MINPHYS	5	LPHYS1241	